

**Examination in MA0002 Mathematical methods B—Appendix**

Saturday 10 June 2006

Permitted aids: Any written and printed material. One calculator.

*Mark one answer for each problem on the form overleaf. You will score one point for each right answer and zero points for each wrong answer. Multiple answers will score zero.*

*Note: There is text on both sides of the sheet. All problems have five alternative answers.*

**Problem 1.** Compute the determinant  $\begin{vmatrix} 1 & 1 & 1 \\ 2 & 2 & 1 \\ 3 & 3 & 1 \end{vmatrix}$ .

- (a)  $-1$    (b)  $0$    (c)  $-2$    (d)  $-3$    (e)  $-4$

**Problem 2.** Let  $z = \sin e^{x+y}$ . Find  $\partial z / \partial y$ .

- (a)  $y \cos e^{x+y}$    (b)  $\cos e^{x+y}$    (c)  $x e^{x+y} \cos e^{x+y}$    (d)  $y e^{x+y} \cos e^{x+y}$    (e)  $e^{x+y} \cos e^{x+y}$

**Problem 3.** Which type of critical point is  $(2, -1)$  for the function  $f$  defined by  $f(x, y) = x^2 + xy + y^2 - 3x$  for all  $(x, y)$ ?

- (a) Saddle point   (b) Local minimum   (c)  $(2, -1)$  is not a critical point   (d) Local maximum   (e) Stirrup point

**Problem 4.** Find the directional derivative of  $x^2 + y^2$  at  $(x, y) = (1, -1)$  in the direction of  $[-3 \ 4]'$ .

- (a)  $0$    (b)  $-2.8$    (c)  $14$    (d)  $-14$    (e)  $2.8$

**Problem 5.** A solution  $x$  of the differential equation  $3x^2 \frac{dx}{dt} + t = 0$  is equal to 2 when  $t = 4$ . Approximately what is  $x$  equal to when  $t = 0$ ?

- (a) 4.52   (b) 5.52   (c) 3.52   (d) 1.52   (e) 2.52

**Problem 6.** Assume that  $x$ ,  $y$  and  $z$  satisfy the system  $x - 3y + 2z = -9$ ,  $3x + 2y + 5z = -3$ ,  $y + z = 0$  of equations. Which is true of the following statements?

- (a)  $y = 0$    (b)  $y = 1$    (c)  $y = 2$    (d)  $y = -1$    (e)  $y = -2$

**Problem 7.** What is the equation of the tangent plane of  $z = x^3 + y^3 + x^2/y$  at the point  $(2, 1, 13)$ ?

- (a)  $2x + y + 13z = 174$    (b)  $16x - y + z = 44$    (c)  $16x - y - z = 18$    (d)  $-x + 16y - z = 1$   
(e)  $-x + 16y + z = 27$

**Problem 8.** The concentration  $y$  (in M) of a substance in a chemical reaction satisfies the differential equation  $dy/dt + y + 4e^{-3t} = 0$ , where  $t$  is time (in ms). At  $t = 0$ ,  $y = 3$ . What is the concentration after 1 ms?

- (a) 0.37 M   (b) 0.47 M   (c) 0.07 M   (d) 0.17 M   (e) 0.27 M

**Problem 9.** 3 mg of a type of albumin is injected into the bloodstream of a patient. The amount (in mg) after  $t$  minutes is  $x$  in the blood and  $y$  in the liver, where  $x$  and  $y$  satisfy the system  $dx/dt = -0.06x + 0.03y$ ,  $dy/dt = 0.06x - 0.03y$  of differential equations. When  $t = 0$ ,  $x = 3$  and  $y = 0$ . How much albumin is there in the liver after one minute?

- (a) 0.17 mg   (b) 0.67 mg   (c) 1.17 mg   (d) 2.17 mg   (e) 1.67 mg

**Problem 10.** Which types of equilibria does the differential equation  $dy/dt = -2(1-y)(2-y)y$  have?

- (a) Two unstable   (b) Two stable   (c) One stable and one unstable   (d) Two stable and one unstable   (e) One stable and two unstable

Problem	a	b	c	d	e
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Studentnummer	Student number

Studieprogram	Study program

Inspektør	Inspector